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Case Report

Surgical Ostioplasty of the Left Main Coronary Artery: An Alternative to Coronary Artery Bypass Grafting in the Treatment of Left Main Stem Isolated Ostial Stenosis—A Case Series

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Abstract: This study aims to demonstrate the use of surgical ostioplasty of the left main coronary artery as an alternative technique to the conventional use of coronary artery bypass grafting for the treatment of left main stem-isolated ostial stenosis. From 2002 to 2021, five patients—three women (60%) and two men (40%)—presented with a history of angina pectoris and were diagnosed with isolated stenosis of the coronary ostia associated with normal distal coronary arteries. Pre-operative cardiac catheterization and echocardiography were performed to aid in the diagnosis. The patients were submitted to surgical ostioplasty with a posterior approach using a saphenous patch. There were no hospital deaths or myocardial infarctions during the post-operative period. The mean cardiopulmonary bypass time was 82 min (range, 70–95 min), and the mean aortic-clamp time was 62 min (range, 55–75 min). The average time of hospitalization was 6.2 days (range, 4–18 days). Patients with isolated stenosis of the coronary ostia associated with normal distal coronary arteries may be submitted to left main coronary artery ostioplasty as an alternative to coronary artery bypass grafting, the traditional surgical technique for this pathology.

Keywords: left main coronary artery; CABG; surgical ostioplasty; isolated ostial stenosis

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1. Introduction

Isolated ostial stenosis of the left main stem coronary artery is a rare cause of myocardial ischemia and angina [1,2]. Although its etiology remains unclear, most cases are presumed to be atherosclerotic in origin [3]. Although the traditional approach is coronary artery bypass grafting (CABG), other treatment options include percutaneous catheter intervention (PCI) and left main coronary ostioplasty. Surgical ostioplasty has emerged as an alternative to the surgical management of patients with isolated left main coronary stenosis without significant calcification [2,4]. In order to contribute to the limited available literature on this pathology, we would like to share the outcomes and report our experiences with surgical ostioplasty for isolated ostium stenosis.

2. Methods

From 2002 to 2021, all patients diagnosed with isolated stenosis of the coronary ostia associated with normal distal coronary arteries and submitted to surgical ostioplasty by the same surgical team in our reference hospital were included in this study.

Patients were diagnosed based on a history of angina pectoris associated with a preoperative cardiac catheterization, presenting with stenosis of the left main coronary artery and normal distal arteries (Figure 1) as well as preoperative cardiac echocardiography demonstrating normal function and valves (Figure 2).

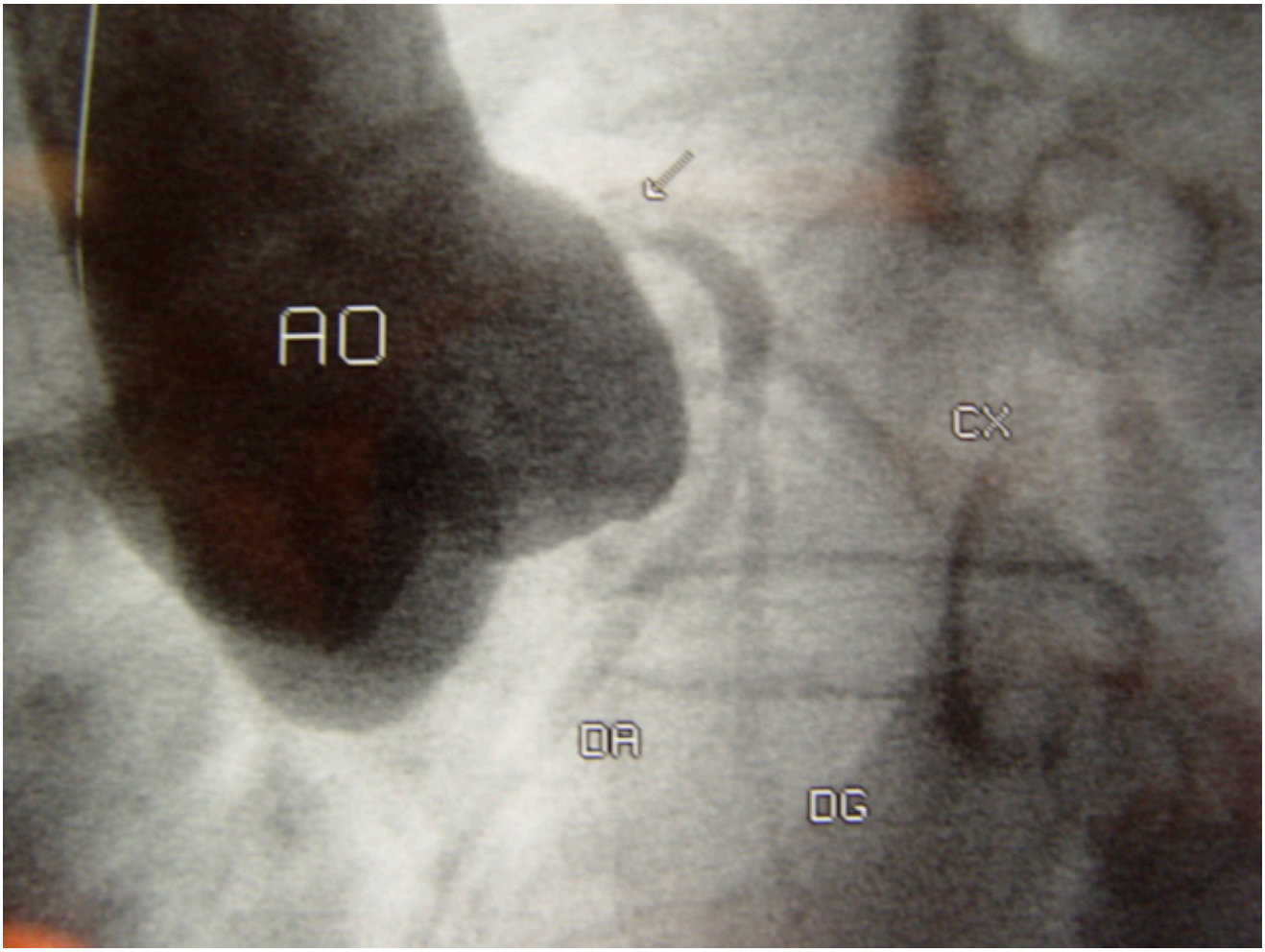

Figure 1. Coronary angiography portraying stenosis of the left main coronary artery (the arrow). Visualization of the normal left anterior descending artery (DA), diagonal (Dg), and circumflex (Cx) arteries.

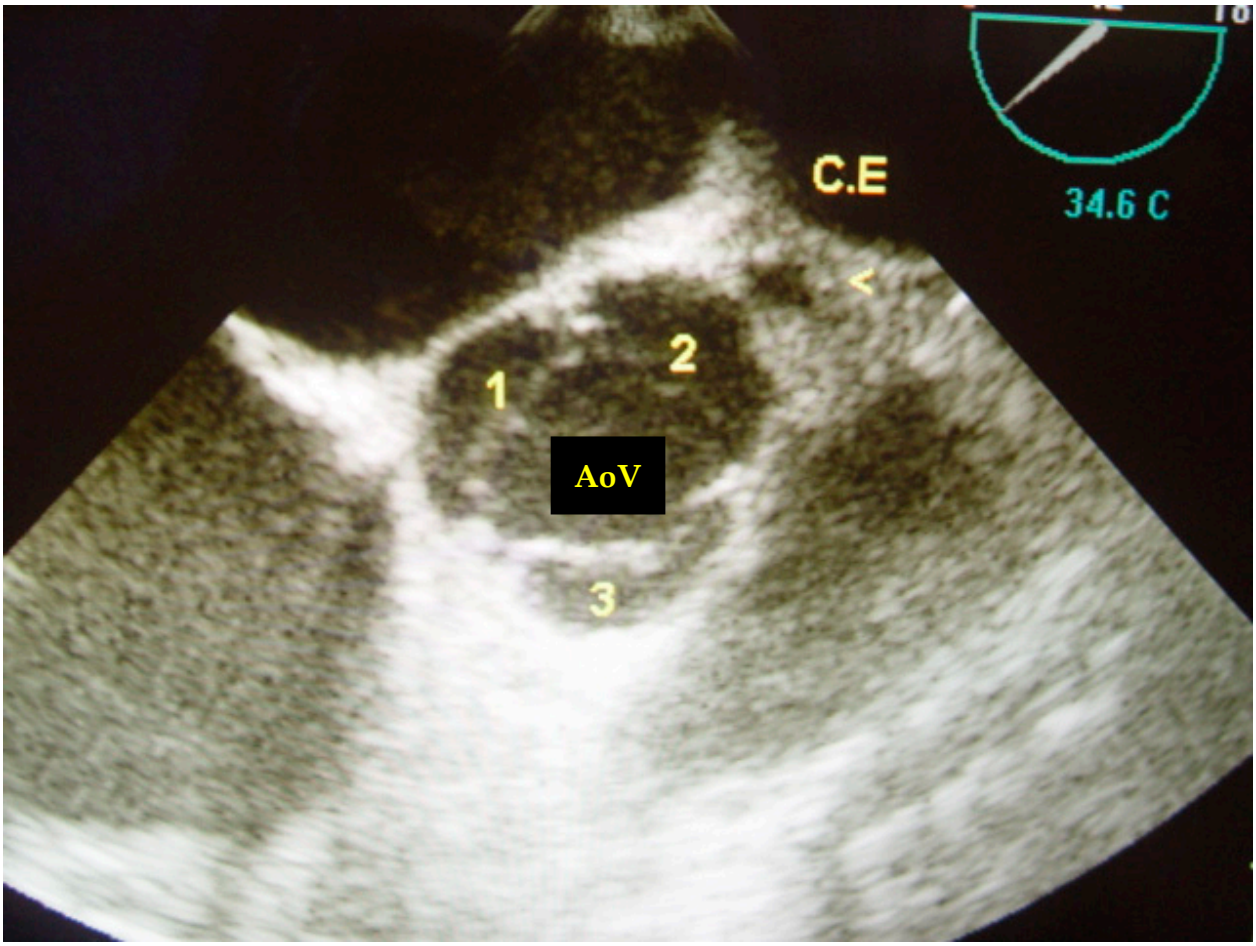

Figure 2. Preoperative transthoracic echocardiography demonstrates normal valves and ventricular function. A stenotic left main coronary artery ostium can be visualized (yellow arrow). AoV = Aortic valve. 1 = Right coronary cusp of the aortic valve. 2 = Left coronary cusp of the aortic valve. 3 = Non-coronary cusp of the aortic valve.

2.1. Surgical Technique

Patients were submitted to general anesthesia; a median sternotomy was performed and a cardiopulmonary bypass with an aortic cannula and single cannula in the right atrium was established. With the patient cooled to 32 °C and under cold blood cardioplegia, transverse aortotomy of the aortic root towards the left coronary ostium with its posterior opening was made. Then, a segment of the saphenous vein was sutured with Prolene 7-0 Ethicon® in the opening that was previously created (Figure 3). Aortorrhaphy with Prolene 4-0 Ethicon® followed in the usual fashion. After cardiopulmonary bypass, with the return to sinus rhythm and hemodynamic stability, the chest was closed.

2.2. Advantages

- Initial option in treating patients who have isolated ostial stenosis with no distal coronary disease [1].
- Arterial and venous conduits are preserved for possible use in the future [2].
- Restores the myocardium's physiologic perfusion, maintains intraluminal access to the distal coronary tree, saves bypass material, and can be performed safely and effectively [2].

2.3. Contraindications

The main contraindication is the presence of calcification [3,4]. Additionally, the extension of the disease into the left main coronary trunk towards its bifurcation should also be regarded as contraindication [4].

2.4. Complications

A major recognized complication of this procedure is restenosis, which was identified in 3 of the 23 patients in our literature survey; two out of the three patients needed to be operated on again [3]. Some other issues such as the need to harvest conduits, progressive occlusion of the left main coronary artery leading to graft-dependent coronary circulation, and atherosclerotic changes of venous grafts (if used) must be accounted for when carrying on with the procedure [2].

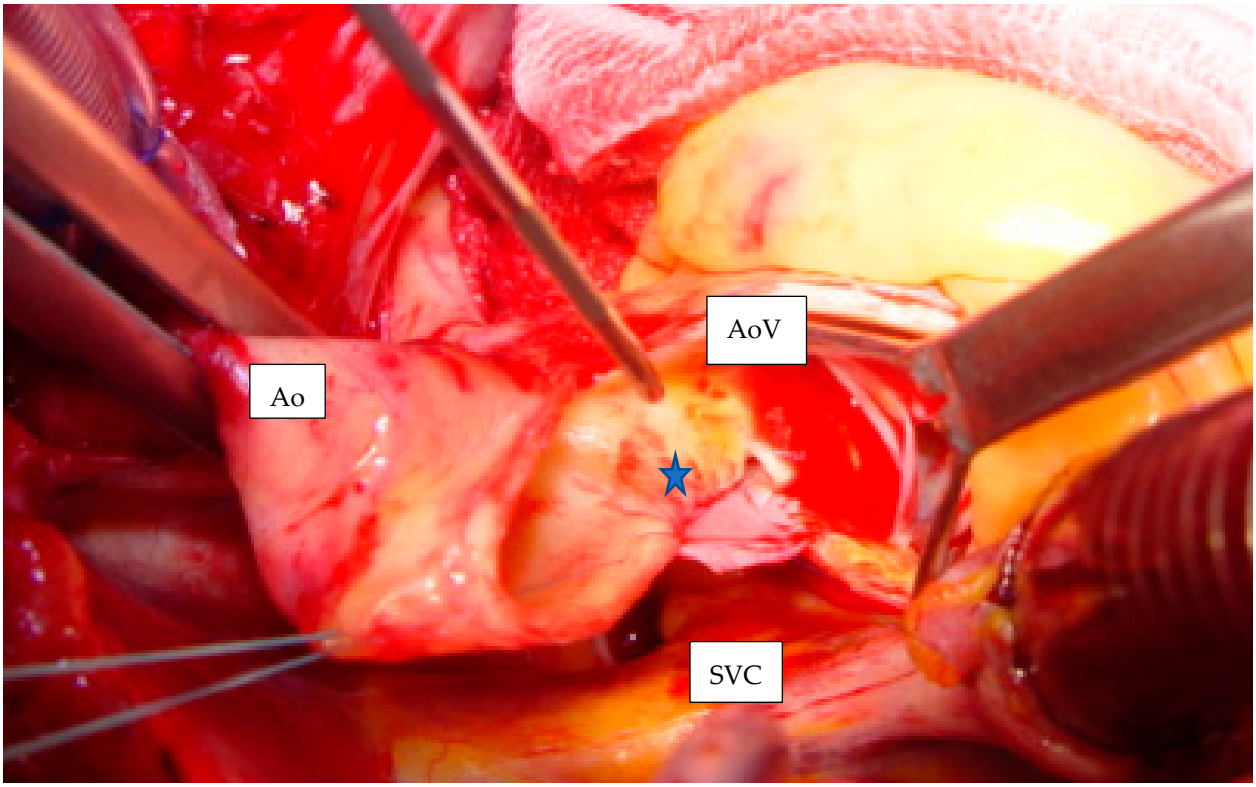

Figure 3. Operative view after transverse aortotomy and posterior opening: enlargement of the ostium of the left main coronary artery with a patch of the saphenous vein (blue star). Ao = Aorta; AoV = Aortic valve; SVC = Superior vena cava.

3. Results

Five patients were included, three women (60%) and two men (40%), with a mean age of 51.8 years (range, 44–60 years). All patients were submitted to surgical ostioplasty of the left main coronary artery with a saphenous vein patch. The mean cardiopulmonary bypass time was 82 min (range, 70–95 min) and the mean aortic-clamp time was 62 min (range, 55–75 min). The average time of hospitalization was 6.2 days (range, 4–18 days) (Table 1). There were no hospital deaths or myocardial infarctions, readmissions, hemorrhagic or ischemic strokes, or implantations of cardiac pacemakers.

Table 1. Patient characteristics.

Patient.	Sex	Age	Time of CPB (min)	Time of Aortic Clamping (min)	Time of Hospitalization (Days)	Type of Surgery	Comorbidities
Patient 1	F	50	70	55	4	Elective	Hypertension, Non-insulin-dependent diabetes type II, dyslipidemia, Obesity
Patient 2	M	44	85	60	4	Elective	None
Patient 3	F	48	70	50	5	Elective	Hypertension
Patient 4	M	57	90	70	17 *	Elective	Hypertension, Chronic obstructive pulmonary disease
Patient 5	F	60	95	75	18 *	Elective	Hypertension and Chronic obstructive pulmonary disease

* Patient 4 and 5 required 7 days of antibiotic use, Piperacillin–Tazobactam, in order to treat a respiratory tract infection and wait for control exams.

Case Description

Patient 5's clinical case will be described as the other patients' clinical presentations were very similar. The patient presented with typical angina pectoris. Their past medical history included hypertension and chronic obstructive pulmonary disease. An electrocardiogram was performed and a T wave inversion was seen on V4–V5, and on V2 a T wave with a plus-minus morphology was observed (Figure 4). Troponin was elevated (0.568 > 0.528) and a non-ST-elevation myocardial infarction was diagnosed. A transthoracic echocardiogram was performed and the patient's ejection fraction was 50%; the heart was of normal dimensions, and segmental contractility alterations were observed. There was mild systolic dysfunction, moderate diastolic dysfunction, and increased left atrium with discrete mitral and tricuspid regurgitation. The patient was then submitted to invasive cardiac stratification with cardiac catheterization and visualization of a severe left main stem ostial lesion with "damping" of the pressure curve. The left ventricle had normal dimensions and anteroapical akinesia. Surgical ostioplasty was indicated and performed as described. Postoperative clinical and hemodynamic recovery was adequate. However, the patient required 7 days of antibiotics—Piperacillin–Tazobactam—used to treat a respiratory tract infection. The patient was discharged after 18 days in good clinical condition, with a good sinus rhythm, and no signs of ischemic or left ventricle overload. At 2, 6 and 17-months follow-up, the patient did not require new cardiovascular intervention, had no arrythmias (follow-up electrocardiogram in Figure 5), denied angina symptoms, and presented with only hypothyroidism and reported one episode of mild epistaxis while using aspirin. At 6 months' follow-up, an ergometric test with pharmacologic stress showed no arrythmias or ischemic changes; myocardial scintigraphy showed a discrete transient antero-septo-apical hypoperfusion of the left ventricle with preserved global function—estimated ejection fraction 58%.

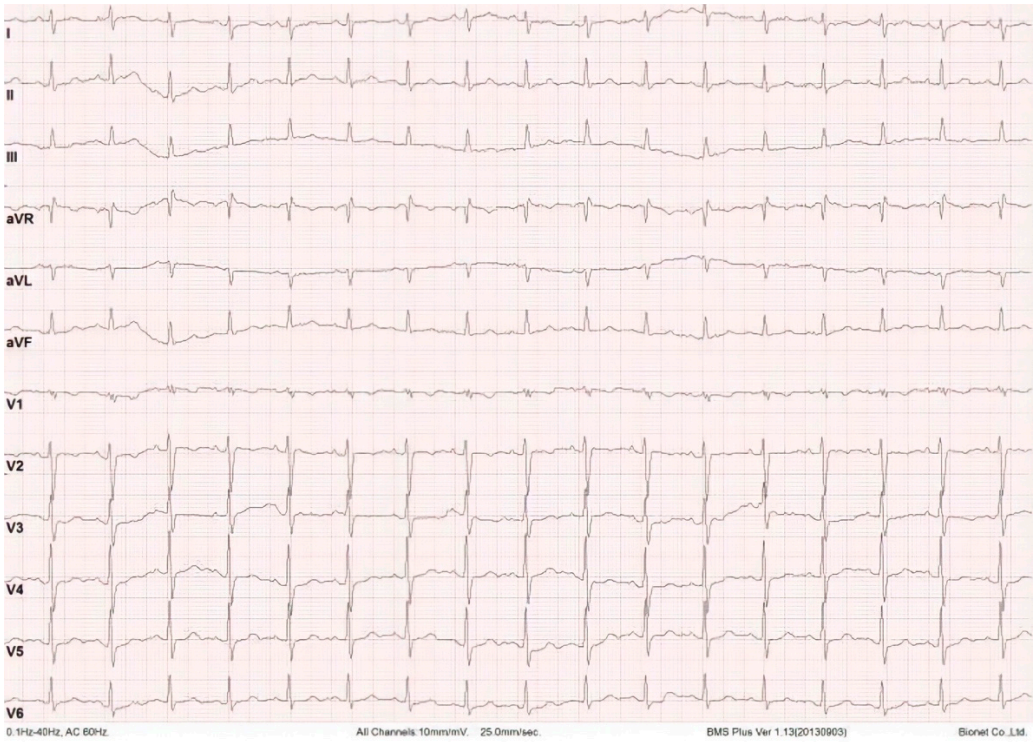

Figure 4. Patient 4's 12-lead electrocardiogram on admission, T wave on V4–V5, T wave with a plus-minus morphology on V2.

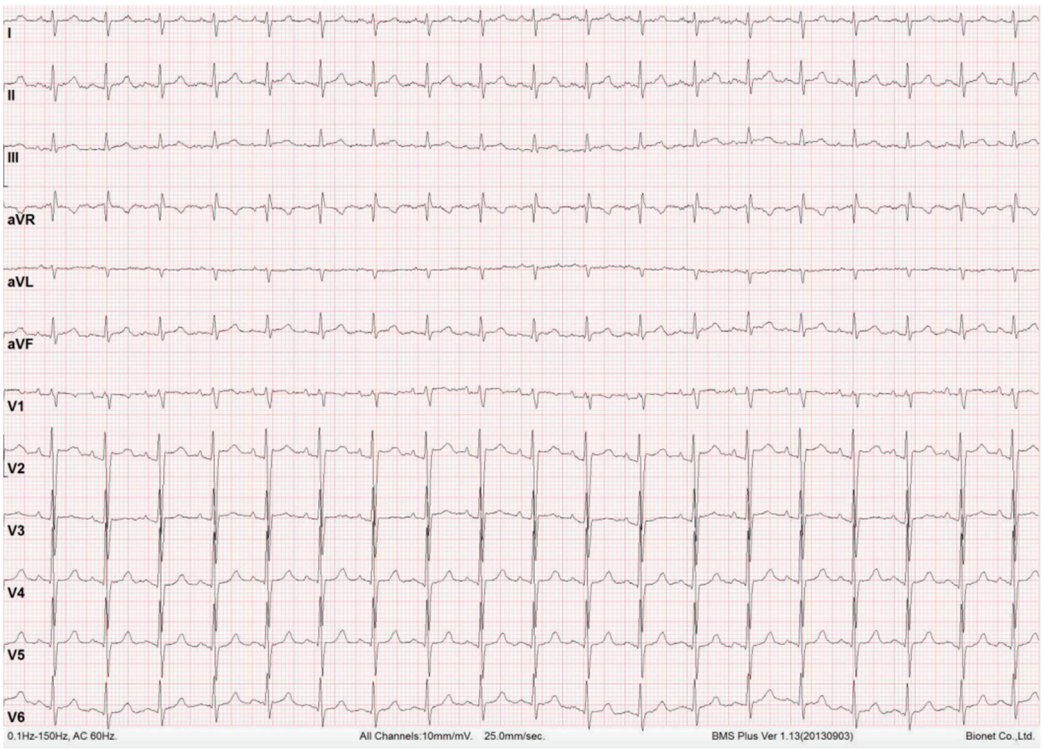

Figure 5. Patient 4's 12-lead electrocardiogram at 15 months follow-up. Discrete sinus tachycardia (Heart rate 107 bpm), normal axis, and no signs of chamber hypertrophy.

4. Discussion

A rare cause of myocardial ischemia and angina [1,2], Thompson et al.—in a large series of patients undergoing coronary angiography—observed isolated stenosis of the coronary ostia associated with normal distal coronary arteries in 0.2% of patients [4].

Its etiology is yet unclear [3], although most causes are presumed to be atherosclerotic in origin [1]; less common causes, such as syphilitic or Takayasu's arteritis [2], fibromuscular dysplasia, fibrous membrane, iatrogenic lesions [1], or abnormal orientation to the aortic wall have also been described [5]. Middle-aged women are primarily affected by this pathology, as seen in our case series [2]. The typical clinical presentation includes a rapid development of unstable angina refractory to medical treatment and complete absence of collateral coronary circulation, leading to a high incidence of sudden death if not treated [6].

Current European Society of Cardiology guidelines on myocardial revascularization (ESC 2018) recommend that patients with low syntax scores ($\leq$22), regardless of the location of the disease in the left main coronary artery, be submitted to percutaneous catheter intervention (Class 1, level of recommendation B). However, this evidence is valid for patients with low-to-intermediate anatomical complexities. In patients with high anatomical complexities—which is the case for these patients with specifically isolated left main coronary ostial stenosis—PCI cannot be endorsed, as reflected by a class III recommendation [7]. The use of PCI in this rare group of patients is—similar to surgical ostioplasty—limited to case reports, and used specifically in patients with protected LCA by previous CABG and patients with good collaterals [8].

Coronary artery bypass grafting is a conventional and safe method of treating stenosis of the left main ostium [2]. However, drawbacks—such as the need for multiple vascular anastomoses, permanent occlusion of the LMS coronary artery, and less physiologic retrograde myocardial perfusion—have been reported. Surgical ostioplasty has been proposed to avoid these problems, and good clinical outcomes have been reported [3]. In addition, surgical ostioplasty preserves arterial and venous conduits for possible use in the future (especially important in pediatric patients) [6], and also restores physiologic perfusion of the myocardium, maintains intraluminal access to the distal coronary tree, saves bypass material, and can be performed safely [2]. Patients should be carefully selected for surgical success [1], and the procedure should only be performed by experienced surgeons due to its technical demands [6].

Although the optimal patch material remains unclear due to the limited number of cases, the most used are segments of autologous saphenous vein, autologous pericardium, bovine pericardium, or internal mammary artery [3,5]. Paolo Angelini et al.'s impressions were that the autologous pericardium is extremely pliable, easy to work with, and avoids the needless harvesting of a saphenous vein when concomitant CABG is not required [1]. Zsolt L. Nagy et al. believe that the right internal thoracic artery is an ideal patch material for ostioplasty of the left main coronary artery, with good early angiographic and functional results [9]. Thus, we can conclude that the limited number of cases does not allow us to draw any verdict on which material is best.

Different techniques have been described to expose the left main coronary artery. These include a posterior, anterior, transaortic, or transpulmonary approach [3]. The ideal approach remains controversial and should be chosen in a case-by-case scenario with the surgeon's preference and experience in mind.

Calcification was found to be the most important contraindication [3,5]. Additionally, the extension of the disease into the left main coronary trunk towards its bifurcation should also be regarded as impeding [5].

Restenosis is an important possible complication of this procedure that may lead to reoperations [3]. Other issues such as the need to harvest conduits, progressive occlusion of the left main coronary artery leading to graft-dependent coronary circulation, and atherosclerotic changes of venous grafts need to be accounted for when carrying on with the procedure [2]. Three-month anticoagulative prophylaxis may be recommended postoperatively for early ostial thrombosis prevention [3].

The limitations of this study, due to the disease's rarity, include a small sample and no control group. However, there would be no statistically significant findings in a study with a control group with such a limited number of patients. A cohort study, or—even better—a clinical trial comparing CABG, PCI, and surgical ostioplasty would be of great benefit; however, none were found in our literature research.

5. Conclusions

In conclusion, surgical ostioplasty can be considered as an initial approach in the treatment of patients who have isolated ostial stenosis but no distal coronary disease [1]. Nonetheless, careful selection of patients, adequate intraoperative myocardial protection, proper enlargement of the ostium without distortion, and efficient postoperative care are vital in achieving good results [10,11]—such as the reduction of cardiopulmonary bypasses and the reduction of mortality and post-operatory diseases.

Lastly, the etiology of the disease must be better understood to enable surgeons to select the most appropriate management approach, to improve the quality of life of these patients, and consequently, to reduce morbidity and mortality.

Author Contributions: A.P.—Substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. P.R.V.d.O.S.—Substantial contributions to the conception or design of the work; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. M.F.P.—Substantial contributions to the conception or design of the work; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. V.d.A.C.—Substantial contributions to the conception or design of the work; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. I.M.R.—Substantial contributions to the conception or design of the work; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. P.R.S.—Substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data for the work; final approval of the version to be published; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. R.d.C.L.—Final approval of the version to be published; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. R.L.—Final approval of the version to be published; agrees to be accountable for all aspects of the work in ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors have read and agreed to the published version of the manuscript.

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